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$$x = (\tfrac{1}{2}a + \tfrac{1}{4}a)\cos\theta - (\tfrac{1}{4}a)\cos[(\tfrac{1}{2}a + \tfrac{1}{4}a)/(\tfrac{1}{4}a)]\theta,$$

$$\text{and } y = (\tfrac{1}{2}a + \tfrac{1}{4}a)\sin\theta - (\tfrac{1}{4}a)\sin[(\tfrac{1}{2}a + \tfrac{1}{4}a)/(\tfrac{1}{4}a)]\theta.$$

These are the well-known equations of an epicycloid, the radii of the fixed and rolling circles being $\tfrac{1}{2}a$ and $\tfrac{1}{4}a$ respectively.

B. The following geometrical solution is very much like one given in *Wood's Optics*, and was suggested by it.

Referring to the same figure, erect at P a perpendicular to CB , meeting OB at E . Comparing the similar triangles EPB and ODB , $ED : DB = BP : BD = 1 : 2$.

If, then, upon EB , the half of OB , as diameter, a circumference be drawn its intersection with CB will be a point of the caustic. With O as center and EO as radius describe a semi-circle, intersecting the X -axis at K .

The $\angle EOK = \theta$, and arc $EK = \tfrac{1}{2}a\theta$.

Also, since $\angle EBP = \theta$, the angle at the center measured by arc $EP = 2\theta$; and arc $EP = \tfrac{1}{2}a \cdot 2\theta = \tfrac{1}{2}a\theta$.

Hence arc $EP = \text{arc } EK$.

The locus of P is, therefore, generated by the circle EPB rolling on the circle EK , the points P and K being originally in contact.

Of course the problem may be solved without assuming the property quoted from *Price*. In *Rice and Johnson's Differential Calculus* an excellent solution is outlined.

Also solved by C. W. M. BLACK, S. H. WRIGHT, and B. F. FINKEL.

PROBLEMS FOR SOLUTION.

ARITHMETIC.

97. Proposed by J. A. CALDERHEAD, M. Sc., Professor of Mathematics, Curry University, Pittsburg, Pa.

In what time will \$4000 amount to \$5134.96, interest at 6% payable annually?

*** Solutions of these problems should be sent to B. F. Finkel, not later than July 10.

GEOMETRY.

97. Proposed by CHAS. C. CROSS, Libertytown, Md.

Prove by pure geometry: The radius of a circle drawn through the centers of the inscribed and any two escribed circles of a triangle is double the radius of the circumscribed circle of the triangle.

98. Proposed by EDW. R. ROBBINS, Master in Mathematics and Physics, Lawrenceville School, Lawrenceville, N. J.

Construct a circle which shall pass through two given points and touch a given circle, (1) when the distance between the points is less than the diameter of the circle, and (2) when it is greater.

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